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Date:_____

Biology
Test 4: Gene Expression & Regulation

2. You and your classmates have recently identified a protein that when found in a mutated form may cause cancer. You have been able to successfully determine the primary structure of the protein (the * is the end of the protein corresponding with the stop codon)

1 mmnvnavyae kcvtpdeavt litsgshlsm gmfaaeppal lnalakrakr geindlrvyc
61 yetasiagnt ifryelsdyi hlysmvspmd kygyfnfgig ndystriart akklivevnk
121 ymprvhgega aihiseidai venhvpliel pirtavaedi aisqiiaslv pdgaclqmgv
181 galpelicna l*

After determining the protein's primary structure, your colleagues suggested that they would be able to determine the **entire and continuous** DNA sequence that encodes the protein. You quickly point out that this would probably be very difficult or even impossible for two different reasons.

What are they?
As you continue your research, you find a protein that functions very similarly in two other tissue samples. Interested to see if these proteins are similar in structure or not, you quickly determine their primary sequences as well: You carefully analyze and compare the primary structures of the three proteins and notice obvious similarities but you find that they are not identical.

Wow! Yo!
B3

Sample 1:
1 mmnvnavyae kcvtpdeavt litsgshlsm gmfaafitgi eralirqgie ssgrkivnyv
61 psnfhqatrl laddigidtf ihtvspmdky gyfnfgignd ystriartak klivevnkym
121 prvhgegaai hiseidaive nhvplielpi rtavaediai sqiiaslvpd gaclqmgvga
181 lpelicnal*

Sample 2:

1 mmnvnavyae kcvtpdeavt litsgshlsm gmfaaeppal lnalakrakr geindlrvyc
61 yetasiagnt ifryelsdyi hlysmfitgi eralirqgie ssgrkivnyv psnfhqatrl
121 laddigidtf ihthiseida ivenhvplie lpirtavaed iaisqiiasl vpdgaclqmg
181 vgalpelicnal*

You report your findings to your colleagues. They immediately suggest that the three proteins must be encoded by three separate genes that belong to a single gene family (a closely related set of genes with similar structure and function). They suggest that some mechanism regulates these genes so that just one is expressed in the different types of tissues you analyzed. You quickly provide another explanation based on your understanding of gene regulation in eukaryotic organisms.

(a) Referring back to the question on Pg 1. (*italicized*). What are the two reasons that would prevent you and your colleagues from determining the **entire and continuous** DNA sequence that encodes the protein?

(b) What is your alternate explanation to your colleagues' theory of the three separate genes

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for these proteins?
(c) Describe the possible relationship between these three proteins by highlighting their similarities leading to your conclusion.
(d) Draw a simple diagram of the gene(s) encoding these proteins to support your answer.

a. The introns that are a part of the DNA are spliced out of the final mRNA, and are therefore not translated into amino acids. So the introns would be missing from the DNA sequence determined by the amino acid sequence. The other reason is the redundancy of the amino acid code, which has more than one possible codon for some amino acids, which means that there would be several possible codons for one amino acid to be translated back into RNA making it impossible to know which one is the real one. 2/2 2/2

b. They all come from one gene, but because of alternative mRNA splicing, they have different exons, making 3 different proteins

c. They all have the same first and last exon from the mRNA.

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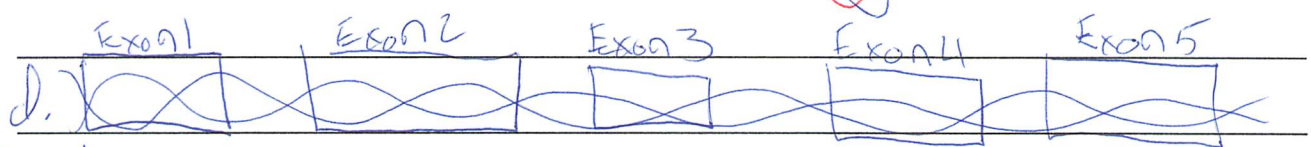
which also happen to be the first and last exons of the gene. The areas that they all have are highlighted in green. The original protein and sample 2 both have the same sequence after the first exon. This area is the second exon of the gene, which we know because it comes before the area highlighted in red in sample 1 but is second in sample 1. the area shared by the original and sample 2 is highlighted in blue. Sample 1 and Sample 2 both have the red area which is the 3rd exon of the gene. The original and sample 1 both have the area highlighted in silver which is the fourth exon of the gene.

5/5 Awesome explanation



d.

transcription ↓

pre-mRNA: Exon1 | Intron | Exon2 | Intron | Exon3 | Intron | Exon4 | Intron | Exon5

splicing ↓

original: Exon1 | Exon2 | Exon4 | Exon5

Sample 1: Exon1 | Exon3 | Exon4 | Exon5

Sample 2: Exon1 | Exon2 | Exon3 | Exon5

Fabulous!

3/3

translation ↓

3 different amino acid sequences

5/5

I have neither given nor received any unauthorized aid on this test. Emily Hazelton